Water Resources Sustainability Project
(WRS)

2000 Annual Report
January 1 to December 31, 2000

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Introduction

This report presents the progress made by the WRS project in calendar year 2000 towards attaining the intermediate results of USAID's environmental strategic objective to "improve water resources management in the urban, agricultural, and industrial sectors". The year 2000 was marked by significant achievements for the project. Both the Drarga wastewater treatment plant and the Dokkarat chromium recycling plant were inaugurated in high profile ceremonies. In Nakhla, we continued to implement soil erosion control activities that are already having an impact on soil loss in the watershed. On the policy front, we prepared a report to help the Ministry of Environment set norms and standards for wastewater reuse. We also honed our communications strategy and develop high impact communication tools that are sharing project successes with a wide audience. The progress made in 2000 is keeping us on track to successfully complete the ambitious agenda of WRS to finish three pilot projects demonstrating innovative approaches to water resources management in the urban, agricultural, and industrial sectors and to begin the successful dissemination of these best practices. As USAID's strategy shifts the focus of activities to the Souss-Massa area, much of the lessons learned from the implementation of WRS activities can be applied to new activities being developed in the Souss-Massa.

Chapter 1 presents more details of the project's progress in 2000. Chapter 2 discusses the progress made towards reaching the project's indicators and intermediate results. We have included many pictures in the report to illustrate our activities. Budget expenditures and a list of reports are included in annexes.

1. Achievements

This section presents a summary of the achievements of the project in 2000.

1.1 Drarga Wastewater Treatment and Reuse Pilot Project

Construction of the wastewater treatment plant

In 2000, we completed the construction of the wastewater treatment plant in Drarga. The plant was inaugurated on October 31st and began operating immediately. Work completed in 2000 included completing filling the sand filters with sand and gravel, installing all pumps, screens, stop plates and accessories, installing the power at the site, completing all hydraulic connections between basins, installing a fence around the facility, and completing access roads around the facility. Tests conducted at the plant in November show that the facility is meeting the targets set for reducing organic pollution (BOD, COD, and fecal coliforms).

Wastewater reuse network

The outlet of treated wastewater has been built. The wastewater reuse network was prepared in 2000 and will be installed in the first quarter of 2001.

House and office

In 2000, we completed the construction of the operator's house and office. Water and plumbing was installed, as well as cabinets, windows, and doors. Ceramic tiles were put in place in the laboratory space, as well as a sink and storage space. In addition to the house and office, we also built a storage depot and an enclosure for the electric transformer unit.

Green spaces

In 2000, we developed green spaces around the site by planting grasses, trees, and flowers. The green spaces were irrigated with treated wastewater after the plant became operational in October.

1.2 Chromium recycling pilot project in Dokkarat

In 2000, we completed the construction of the chromium recycling plant in Dokkarat. The plant was inaugurated on June 5th, after the completion of the construction and the installation of the equipment to mark World Environment day. The key achievements are described below.

Separation of tannery effluents

The separation of tannery effluents in the 16 tanneries of Dokkarat was completed in 1999. In 2000, the tanners improved the separation systems by building catch basins under the tanks containing chromium. This improved system will minimize losses of chromium

effluents within the tannery and will prevent chromium effluents from being mixed with other tannery releases.

Construction of the piping network

In 2000, we tested the piping network that was built in 1999 for leaks. We detected several leeks in the system and we asked the contractor to fix them according to rigid specifications consistent with the requirements of the environmental impact assessment. The repair of the entire piping network was nearly complete by the end of 2000.

Installation of equipment

The chromium recovery plant requires specialized equipment (tanks, pumps, filter press). The equipment for the plant was purchased in the United States and shipped to Fes in April 1999. In 2000, all of the equipment was installed at the facility, including tanks, filter press, screen pumps, H2S detector, and compressed air tanks. In addition, we installed a fiberglass tank for the storage of sulfuric acid that was manufactured in Morocco, an electronic command center, pipes, valves, and accessories.

Construction of the facility

The construction of the facility was completed in May 2000. The walls had to be constructed first to allow for the large pieces of equipment (i.e., fiberglass tanks) to be placed in the facility by crane. Following the installation of the tanks, we installed a pre-fabricated roof made of 12 meter reenforced concrete beams. In addition to the chromium recovery facility, we also built an office and a guard house on site, at the request of the RADEEF.

Construction of the mezzanine

A mezzanine in galvanized steel was installed inside the plant in 2000. The first level of the mezzanine holds the filter press. The second level holds a screen and allows operators to service the large settling and precipitation tanks.

Installation of electric transformer

In 2000, we installed an electric transformer on site to provide electricity to the plant. A small structure had to be constructed first to house the transformer.

1.3 Soil erosion control project in Nakhla

In 2000, WRS and its partners continued to implement soil erosion control activities in the Nakhla watershed. Below are descriptions of specific activities undertaken in the Nakhla watershed in 2000.

Olive Tree Planting

During the year, 22,000 locations were identified on 110 ha of land in zones 2 and 3 for olive tree plantings. An additional 30,100 locations were also surveyed in order to plant an additional 215 ha with olives beyond zone 3 in response to a great demand for trees from the villagers. By the end of the year 2000, a total of 765 ha of land have been planted with 83,000 olive trees. Another 12,000 sites in zones 1-3 will be replanted with olive trees to replace trees that have died during the two years of drought or have been illegally eaten by grazing livestock.

Farmers are extremely pleased with the olive tree planting program. They understand that when these trees begin producing olives, the household income of project cooperators has the potential to increase significantly. Cooperators in each zone have requested that the project provide a few collective olive oil extraction units to process the olive crop once significant quantities of olives are produced.

One difficulty associated with the olive tree plantations is the lack of grass forage strips planted between trees. Only 2 ha of grass strips have been planted to date. Farmers do not understand the value of these strips for forage production or erosion control. The strips create difficulties for the farmers in tilling their land, since they cannot plow up and down the slope with the strips in place. Additional demonstration plots and training sessions are required to increase the adoption of this valuable practice.

Protection of Olive Tree Plantations With Guards

Grazing by goats has been largely controlled during the third year of the project. This was achieved by hiring four guards to protect trees from animal grazing. Trees in most areas of zones 1, 2, and 3 are quite healthy. A visual survey of olive tree plantings during a field trip in November showed that there is considerable wheat residue and weedy growth remaining on lands where olive trees were planted, indicating that animals have not grazed these lands since harvest. In contrast, land without olive trees has very little crop residue.

Development of Supplemental Irrigation Water Sources for Olive Tree Plantings

Damages by drought during the summer have largely been ameliorated in Zone 1 after construction of 7 water reservoirs by WRS. Each reservoir has a water storage capacity of 10 cubic meters. Visual inspection of reservoirs during November of 2000 showed that they were full of water, despite the two years of drought. The water is supplied by springs, which have been developed and improved by WRS.

Construction of Cuvettes Around Planted Olive Trees

During an intensive training program from April to June, WRS and the DPA's Work Center in Ben Karrich motivated farmers to rebuild and maintain cuvettes around a majority of already planted olive trees. Farmers understand that properly maintained cuvettes capture runoff water that can be used to stimulate the growth of their trees. With Agricultural Development funds and National Promotion funds provided by the DPA, the Work Center

and WRS were able to build new cuvettes around 32,000 olive trees on roughly 240 ha of newly planted land. In Zone 3, thirty laborers were hired to help construct cuvettes. As a result, all of the 83,000 olive trees planted by the project now have cuvettes, a tremendous accomplishment, considering that after the first year of olive tree plantings no trees had cuvettes and farmers did not view cuvettes as being necessary.

Application of Fertilizer to Olive Tree Plantings

Fertilizer for olive trees was applied to olive trees in Zones 2 and 3 after construction or maintenance of cuvettes. Ammonium sulfate fertilizer was applied at a rate of 0.5 kg per tree.

Improved Access to Agricultural Management Tools

Dryland agricultural lands in Oued Nakhla are managed using traditional methods, including wooden plows pulled by animal traction. Modern tools are generally not available for routine practices such as spraying of herbicides and insecticides, pruning trees, sawing or chopping wood, or plowing. WRS and the Work Center have started to make available modern agricultural tools for loan to cooperators. WRS purchased 2 motorized sprayers, 50 hand sprayers, 50 pruning shears, 50 saws, and 5 axes for loan to cooperators through the Work Center.

Stabilization of Ravines

Check dams and gabions installed along 1.5 km of ravines in Zone 1 have filled in with sediment and rocks from slumping banks along the ravine. These banks have been systematically planted at spacings of about 9 m in March and April with 8,000 acacia and 5,000 carob tree seedlings. The acacias have survived through November, but 90% of the carob tree seedlings have died or are in very poor shape. The carob tree seedlings were very small (less than 1 cm in height), and were susceptible to drought. The acacia seedlings were typically about 1 m in height, and were less susceptible to drought.

The systematic planting method of acacias left large areas along the ravines devoid of stabilizing vegetation. These bare areas are continuing to slump, generating tons of sediment that fills in behind dams and gabions. A planting campaign targeted to these bare areas is needed. These bare areas can be stabilized by planting three rows of acacias or oleanders across the bare soil.

Improvement of Goat Breeding Stock

Improved goat breeding stock (Morceano) from Spain, purchased by the Agence du Nord, were distributed to farmers in four zones of the project in August, 2000. Under the supervision of the Judge in Beni Hassan, the local authorities, the Village Committees, WRS consultants, and the DPA at Tetouan, title was transferred to 24 breeders.

About 4,000 head of goats in the Oued Nakhla watershed were immunized by the DPA

during two cycles in June and December of 1999 to prevent the spread of disease from unimproved to improved goats.

Another 26 Spanish goats are currently under quarantine in Mdiq. These will be distributed to another set of breeders within a period of 6 months.

Development of Beekeeping Production System

During 1999, the Agence du Nord purchased 100 beehives for distribution in Zone 4, where the mattoral is in very good condition for producing nectar needed by bees. They also purchased two sets of beekeeping equipment for use by a collective of 25 cooperators who manage the beekeeping operations. This equipment includes protective suits, knives, collectors, smokers, extractors, vats, and tubs. Also in 1999. The Work Center and DPA identified 25 cooperators who were willing to work together in managing the beekeeping operations.

The severe drought of 1999-2000 reduced the availability of flowers and nectar for bees, causing the loss of 25 hives through lack of food and increased susceptibility to diseases. These hives will be replaced in the coming months. Villagers in the beekeeping cooperative have lost some confidence in the potential economic benefits of beekeeping ventures. They realize the indirect benefits these operations have on erosion, because there is an incentive to protect the mattoral from wood cutting activities.

Rehabilitation of Rangeland and Degraded Mattoral

Reseeding of private rangelands occurred on 12.5 ha of land belonging to 8 cooperators in Zone 2. However, plans for widespread rehabilitation of private rangeland and publicly owned degraded mattoral have been seriously delayed due to social attitudes. These attitudes include a lack of understanding about the importance of erosion from the mattoral, and the traditional use of these lands for animal grazing.

Development of Irrigated Fruit Tree Production

In preparation for distribution of fruit trees to owners of irrigated terraces, a workshop was held in January 2000 on fruit tree planting techniques. This workshop covered the four main varieties preferred by farmers, including apples, pears, quince and prunes. Planting techniques and watering techniques were explained to 32 cooperators.

Rehabilitation of Irrigation Systems

WRS and the DPA prepared a Request for Proposal (RFP) for the rehabilitation of 2 km of irrigation networks in Zone 1. Open channels will be lined with concrete, and losses of water at high gradient portions of the conveyance system will be reduced significantly. This plan will be implemented in 2001.

Development of a GIS for the Nakhla Project

WRS consultant Mohamed Khatouri developed Geographic Information System (GIS) thematic coverages and applications for the Oued Nakhla watershed. The objectives of this work were to provide visualization capacities of project activities, to estimate impacts of project activities on erosion and sediment transport to the Nakhla Reservoir, and to assist in dissemination of project results. In addition, WRS provided training on GIS applications for soil erosion control to staff from MOE, the Ministry of Agriculture, and the DPA of Tetouan.

2. Progress towards objectives

This section shows how the activities undertaken by WRS in 2000 will help us reach the project's indicators of performance and intermediate results. WRS is responsible for reaching targets for six indicators of performance under former Strategic Objective 2 of USAID:

- Indicator 2.1: Amount of water pollution in target areas
- Indicator 2.2: Amount of water savings in target areas
- Indicator 2.3: Volume of soil erosion in target areas
- Indicator 2.1.1: Progress towards the adoption of key policy reforms
- Indicator 2.2.2: Percent of tanners adopting chrome recycling technologies
- Indicator 2.3.1: Number of environmental activities implemented with non-governmental partners

2.1 Indicator 2.1: Amount of water pollution in target areas

This indicator is reached through implementation of the chromium recycling facility in Fes and of the wastewater treatment plant in Drarga. In 2000, we completed the Drarga wastewater treatment plant. The plant was inaugurated on October 31st in a ceremony attended by Minister of Environment Yazghi and the U.S. Ambassador. The plant's performance shows a significant reduction in water pollution. Table 1 summarizes the results of sampling taken in November. We have clearly met the targets set for the indicators of organic pollution in Drarga (i.e., BOD, COD, and fecal coliforms). Because the facility had not been operating for long, nitrate results are not yet available.

Table 1
Treatment Efficiency of the Drarga Wastewater Treatment Plant
(results of analyses taken the week of November 10th, 2000)

Sampling Point	Total Suspended Solids (mg/l)	BOD_5 (mg/l)	Fecal Coliforms (nb / 100 ml)
Incoming effluent	476	775	$1.9 * 10^7$
After anaerobic basin	180	250	$4 * 10^3$
After regulation basin	100	200	$3 * 10^3$
After sand filters	32	5	$< 10^3$

Although the Dokkarat facility was not operational at the end of 2000, substantial progress was made towards the completion of the facility. All the construction work and the installation of equipment is complete. The electricity has been installed at the site by the

RADEEF and the chromium transportation network has been thoroughly tested. The plant was inaugurated in early June by Minister of Environment Yazghi and the U.S. Ambassador.

In July, Dave Bennett, the plant designer was in Morocco to test the facility. After a thorough inspection of the facility, Mr. Bennett made a list of items to be completed by the contractor to ensure maximum operational safety within the plant, and the integrity of all equipment. In the third and fourth quarters of 2000, the contractor completed the list of items to be rectified. We began testing the plant's equipment in the fourth quarter. Since the facility was not operational at the end of 2000, we did not meet the target for pollution reduction from chromium releases in Dokkarat.

2.2 Indicator 2.2: Amount of water savings in target areas

This indicator is primarily affected by the Drarga wastewater treatment and reuse project. To the extent that treated wastewater is reused, alternative sources of water are saved. Farmers that are using treated water from the Drarga plant will not have to pump the aquifer. By the end of 2000, the

The soil erosion control project in Nakhla will eventually increase the holding capacity of the Nakhla dam, leading to water savings. In 2000, we reached our soil erosion control targets with our activities in the watershed. We expect that, in the long run, the rate of loss in the holding capacity of the Nakhla dam will decrease, leading to a longer lifetime of the dam.

2.3 Indicator 2.3: Volume of soil erosion in target areas

The pilot project has generally been on target with respect to indicators of progress identified in the 2000 Workplan (see Table 3). Estimates in the reduction of soil loss as a result of project activities are complex. To estimate the impact of the project on soil erosion rates, we used the universal soil loss equation (USLE):

$$A = R\,K\,LS\,C\,P$$

where:

A is estimated annual soil loss
R is the rainfall erosivity factor
K is the soil erodibility
LS is the slope length and steepness factor
C is the cover management factor
P is the conservation practice factor

Each activity contributed differently to reducing soil loss. As an example of the impact of project activities on soil erosion, consider the following scenario. Olive trees with cuvettes have been installed on 550 ha of rainfed agriculture in Zones 1, 2, 3, and beyond. This land has a rainfall erosivity of 144, a soil erodibility of 0.3, and an LS factor of 8. With

conventional rainfed management before the project implementation activities (C factor 0.6, P factor 1.0) erosion rates on this land would have been about 207 ton/ha/yr. After olive tree plantings (Cfactor 0.45, P factor 1.0) erosion rates have been reduced 25% to 156 ton/ha/yr. In seven to ten years, when the olive trees mature (C factor 0.05), erosion rates will be reduced by 92% to 17 ton/ha/yr.

The impacts of this scenario on erosion and sediment transport in Oued Nahkla can be evaluated after multiplying erosion rates by the area of land planted to olive trees (550 ha). With conventional management, these 550 ha produce 114,048 tons of eroded sediment annually. With immature olive trees and cuvettes, eroded sediment decreases to 85,635 tons. When these trees reach maturity, eroded sediments will decrease to 9,515 tons. The total mass of sediment conserved with olive tree plantings is 28,413 tons for immature trees and 104,533 tons for mature trees. These results are summarized in Table 2.

Table 2
Estimates of Project Impacts on Erosion In Oued Nakhla Before and After Olive Tree Plantings with Cuvettes on 550 ha of Fields With a Wheat-Legume Rotation

	Wheat-Legume	**Immature Olive Trees**	**Mature Olive Trees**
Erosion Rate (t/ha/yr)	207	156	17
Erosion Mass (t/yr)	114,048	85,635	9,515
Erosion Reduction (t/yr)	-	28,413	104,533
Erosion Reduction (%)	-	25%	92%

At a sediment delivery ratio of 0.15, a typical value for a 114 km^2 area watershed, these 550 ha of land deliver 17,107 tons of sediment annually to the Nakhla Reservoir under conventional management, 12,845 tons under immature olive trees, and 1,427 tons under mature trees. In the long-term (under mature trees), these 550 ha of land with mature olive trees will deliver to the Reservoir 15,680 tons/yr of sediment less than the same land under conventional management. Since the Reservoir is currently filling in at a rate of about 160,000 tons of sediment per year, the 550 ha of land planted with olive trees will reduce the rate of infilling by 10% per year.

Ravines are a significant source of sediment in zone 1. Many of the gabions and check dams are completely filled with large stones and sediment, thus reducing the operating efficiency of these structures. The source of this debris is slumping banks along the ravines.

WRS conducted repeated topographic surveys along 95 cross-sections of ravines extending for almost 500 m in zone 1. Subtraction of the cross-section surveys on successive dates gives the cross-sectional area of soil lost by slumping of the banks along ravines. The

average rate of soil loss from these ravines was 345 tons/yr for each linear kilometer of ravines. The catchment area for ravines in this survey was an area of 5.2 ha. Thus, the ravines produce an average rate of 33 tons/ha/yr of soil loss. In comparison, the surrounding agricultural land in conventional management has an average rate of 207 tons/ha/yr of soil loss. Thus, ravines produce less soil loss than agricultural land.

Table 3
Indicators of Project Success

Indicator	Target	Actual Quantity
✓ Sign Workplan Agreement with Project Partners	1	1
✓ Olive Tree Plantings	42,000	21,700
✓ Cuvette Construction	143 ha	110 ha
✓ Hire Guards for Trees	4	4
✓ Buy fruit trees for terraces	5,000	10,000
✓ Grass Strips Between Trees	170 ha	2 ha
✓ Reduced Erosion	25%	25%
✓ Number of farmers and families trained in conservation techniques		
✓ Number of workshops and training sessions	- 9	398+ 11
✓ Distribute cookstoves	8	-
✓ Planting of ravines	1.5 km	1.5 km
✓ Distribute Spanish Goats	25	24
✓ Reseeding Rangeland	100 ha	12.5 ha
✓ Beekeeping Operations	100	100
✓ Rehabilitate Mattoral	24,000 trees	-
✓ Plan for Irrigation Canals	zone 1	zone 1

2.4 Indicator 2.1.1: Progress towards policy reforms

In 2000, Dr. Dimitri Xanthoulis was fielded to prepare a background document for norms and standards for the reuse of treated wastewater. This document was submitted to the Department of Environment for its review. This document will be submitted to the inter-ministerial norms and standards committee that is responsible for recommending norms to the National Environment Council. Norms and standards for wastewater reuse will eventually have to be enforced by the River Basin Agencies (RBAs) that are responsible for the application of the Water Law 10-95.

In 2000, the visibility of MOE was enhanced by the inauguration of the Dokkarat chromium recovery plant in June and the Drarga wastewater treatment plant in December. These events were given intensive media coverage and the role of MOE in the projects was prominently featured. The Department of Environment prepared a blueprint for the activities of a regional office in Agadir. This office, which will be under the purview of the Regional Environmental Inspector, will be operational in 2001.

The application of the polluter-pays principle is not yet in force in Fes, since the Dokkarat chromium recovery plant was not operational at the end of 2000.

The application of progressive tariff policies was significantly advanced in Drarga. The Commune of Drarga has signed a memorandum of understanding in which it is committed to increase the sewage tariff by 1DH per m3, and to set the sewage connection fee for new dwellings at 2,000 DH. These fees will help pay for the operation of the wastewater treatment plant.

We held two lessons learned workshops for the Drarga and Nakhla pilot projects. The goals of these workshops were to discuss with project partners the lessons from the implementation of the projects. We discussed the successes and difficulties of implementation, what approaches or steps could be done differently, and the recommendations for future projects. The lessons learned workshop for the Drarga wastewater treatment and reuse project was held on November 1st in Agadir, and the lessons learned workshop for the Nakhla soil erosion control project was held November in Meknes.

All of the activities we have undertaken in the policy area help us reach the indicator of progress towards key institutional reforms including: industrial norms and standards, progressive pricing policies, increased status of MOE, empowerment of water users association, and the application of the polluter-pays principle.

2.5 Indicator 2.2.2: Percent of tanners adopting chromium recycling technologies

In 2000, the tanners of Dokkarat improved their chromium separation systems by installing catch basins under the tanks containing chromium. This improved system will ensure that the maximum quantity of chromium effluent from each tannery will reach the chromium recovery plant, and will minimize the mixing of chromium effluents with other effluents. The second phase of the adoption of chromium recycling technologies by the tanners of Dokkarat will occur in 2001, after the chromium recovery plant starts operating.

In addition, WRS co-financed with the French Agence Francaise de Développement a demonstration of “clean tanning”technologies in the Ain Nokbi industrial area of Fes. The drums containing chromium were refurbished and the motors adjusted to run at higher speed. Three separate trials were done with new generations of chromium salts and with tanning techniques that allow for a higher fixation rate, thus reducing the chromium concentrations in the final effluent. The tests showed an average reduction of 50% in chromium

concentrations. Three tanners from Ain Nokbi participated in these trials. While the adoption of this technology is not chromium recycling, it is a pollution prevention measure that reduces chromium concentrations.

2.6 Indicator 2.3.1: Public participation for environmental action

Public participation activities have continued to be an important part of the WRS project in 2000. In Drarga, we started the process of creating an association of users of treated wastewater for irrigation. This association will purchase water from the commune and will distribute the water to 23 farmers with fields adjacent to the wastewater treatment plant.

In Fes, the tanners of Dokkarat continued to be involved in project activities by improving the separation system for chromium effluents within their tanneries.

In the Nakhla watershed particularly, public participation activities occurred throughout the year. WRS consultants had regular meetings during the year 2000 with Community Associations and farmers in each of the four project zones. In general, they meet twice with the Community Associations before implementation of any project activity, and once afterwards. WRS consultants and personnel also regularly met with governmental project cooperators at the county and provincial levels.

Village committees play a crucial role in conveying farmer needs to project partners. For example, the drought of the last 2 years caused serious threats to the sustainability of olive tree plantations. Farmers proposed construction of reservoirs to be used in storing water from several springs. This sentiment was conveyed to project leaders through the Village Committees. Project partners responded to farmer needs in a direct, rapid fashion by constructing 7 storage basins in zone 1. As a result, farmers now have an emergency source of irrigation water for olive trees, reducing mortality.

■ Education and Training Activities

The Work Center in Beni Karrich, along with WRS, continues to provide high quality on-site training for project beneficiaries in the Oued Nakhla watershed. The effectiveness of these training sessions is high, due to reliance on hands-on demonstrations, field visits, use of photographs, and handouts. The training sessions have reached at least 398 farmers in the year 2000. Surveys of farmers showed that they were very satisfied with the training sessions.

- The Work Center conducted several workshops on construction of cuvettes around olive trees, starting in April and continuing through the end of June. At these workshops there were demonstrations showing how to make cuvettes and the benefits derived from them. These benefits include capture of water to allow better growth of olive trees, collection of soil eroding from upslope cultivated areas, and a well-defined area in which fertilizer can be placed.

- In June a workshop was held on beekeeping techniques for 10 cooperators in Zone 4.

The workshop focused on methods for recovery of honey, preventative treatment of diseases and pests that affect bees, and supplemental feeding for bees during periods of drought.

- In June there were two workshops on goat production and management techniques. The workshops focused on feed and nutrition, and on sanitation and hygiene.

- Several training activities focused on the Woman's Association in Zone 1. In January, discussions were held with these women on improved cookstoves. Much of the discussion involved the issue of individual versus collective cookstoves. The Work Center proposed providing 4 collective cookstoves, and after some hesitation, this approach was agreed upon by the Village Committee. A field trip to a Woman's Cooperative in Chefchaouen was held in late January to observe a successful situation involving collective cookstoves. Introduction of such cookstoves can reduce the amount of wood burned by 38%, equivalent to 4.9 tons/yr for each household. Also in January, the Woman's Association in Zone 1 discussed options for raising small animals to supplement household income. The women expressed an interest in chickens and rabbits. In March representatives of the Woman's cooperative, the WRS project, and the Work Center met with the Judge in Beni Hassan.

- Training sessions were held for 21 farmers on grass buffer strips between olive trees at demonstration sites on 2 ha of private land. This practice has great potential to reduce erosion by trapping sediment and encouraging contour tillage and farming practices. It also has great potential to provide high quality forage material for animals if cut during the fall, stored, and fed to animals during the winter months.

- Several workshops were held that deal with improved methods for cultivation of olive trees. One workshop addressed application of fertilizer. Farmers were informed of the benefits of fertilization, and the proper rates and times of application. Another series of six workshops dealt with control of diseases and pests in olive trees. After the workshops, many farmers sprayed their own trees. For instance, at the workshops in Zone 2, 13 participants treated 1,729 olive trees representing 10% of the trees in that zone.

- The Work Center established several crop production demonstration sites during the months of November and December in each of the four project zones. These demonstrations are of two major types, namely; wheat variety trials and forage variety trials.

A total of 65 farmers were taken to these demonstration plots to observe the advantages of improved management techniques for wheat production.

■ Other activities

In 2000, WRS participated in the preparation of a workshop on integrated water management in the Souss-Massa that was held in Agadir in April. The workshop, prepared by Chemonics International, was partly supported through WRS funding. The goal of the workshop was to present the principles of integrated water resources management in the context of the Souss-Massa and to provide a platform to launch the new USAID environmental Stratgeic Objective 6, focusing on water management in the Souss-Massa.

WRS also participated in SIWM activities, such as the work plan review and the review of indicators of performance. Throughout the year, we organized a number of visits to all three project sites for U.S. Embassy staff and USAID visitors to Morocco.

In January, a paper on the Drarga wastewater treatment and reuse project was presented at the Water Reuse 2000 conference in San Antonio, Texas by Thor Young of Stearns & Wheler (the designer of the plant under an subcontract with ECODIT). In July, we presented a poster on the Drarga project at the International Water Association conference held in Paris. In September, the WRS Chief of Party, assisted in a presentation of the USAID/Morocco's water program at a USAID conference held in Sharm-el-Sheikh, Egypt. In October, WRS participated in a symposium on environmental technologies held in Fes in which a site visit to the Dokkarat plant was organized for the participants.

3. Field Missions in 2000

Below is a summary of missions fielded by WRS during 2000.

- ***Xavier Guillas*** (ECODIT) was fielded in February and March to ensure compliance of the assembly of the Dokkarat chromium recovery facility with design specifications.

- ***Jalil El Fadli*** (Chemonics) was fielded in March to prepare press articles on WRS activities.

- ***Marie Aziz (Chemonics)*** was fielded in April to conduct an internal review of accounting and recordkeeping procedures for WRS.

- ***Fouad Rachidi (University of Georgia)*** was fielded in April, May, and June to assist with soil erosion control activities in the Nakhla watershed.

- ***Brahim Hafidi (Chemonics)*** was fielded in April to assist with the workshop on integrated water management in the Souss-Massa.

- ***John Woods (Chemonics)*** was fielded in May to assist in revising the WRS communication strategy.

- ***Joseph Karam (ECODIT)*** was fielded in May to assist the Commune of Drarga with the management of the Drarga wastewater treatment plant.

- ***Mohamed Mounsif (University of Georgia)*** was fielded in June to assist with the distribution of goats in the Nakhla watershed.

- ***Mohamed Khatouri (Chemonics)*** was fielded in June to assist with the development of GIS tools for the Nakhla soil erosion control project.

- ***Mohamed Sarehane (Chemonics)*** was fielded in June to assist with beekeeping activities in the Nakhla watershed.

- ***Xavier Guillas (ECODIT)*** was fielded in June to assist the RADEEF prepare for the management of the Dokkarat chromium recovery plant.

- ***Jean Tilly (ECODIT)*** was fielded in June to assist with the start-up of the Dokkarat chromium recovery facility.

- ***Driss Messaho (ECODIT)*** was fielded in June to conduct tests of the chromium separation systems within the tanneries of Dokkarat.

- ***Dimitri Xanthoulis (Chemonics)*** was fielded in July and August to prepare a document on norms and standards for the reuse of treated wastewater.

- ***Jean Tilly (ECODIT)*** was fielded in August as Interim Chief of Party while Mr. Kerby was on annual leave.

- ***John Woods (Chemonics)*** was fielded in October to assist in the development of the WRS marketing strategy.

- ***Mohamed Khatouri (Chemonics)*** was fielded in October to assist WRS in developing a GIS system for soil erosion control activities in Nakhla.

- ***Joseph Karam (ECODIT)*** was fielded in October and November to help prepare a lessons-learned workshop and report for the Drarga project.

- ***David Mulla (Chemonics)*** was fielded in November to assess the progress of the soil erosion control activities in Nakhla.

- ***David Swift (University of Georgia)*** was fielded in November to assist in the preparation of a lessons learned workshop and report for the Nakhla soil erosion control project.

- ***Driss Messaho (ECODIT)*** was fielded in November to assist the RADEEF with the start of the chromium recovery plant and to monitor replication activities in Ain Nokbi.

- ***Jean Tilly (ECODIT)*** was fielded in November and December to assist with the preparation of the 2001 Work Plan.

- ***Rachid Bouabid (Chemonics)*** was fielded in November to assist with the measurement of soil loss in the Nakhla watershed.

- ***Mohamed Kastou (ECODIT)*** was fielded in November and December to oversee the start-up of the electrical equipment in the Dokkarat chromium recovery plant.

- ***Mohamed Sarehane (Chemonics)*** was fielded in November to monitor the progress of the beehives introduced in the Nakhla watershed.

- ***Brahim Soudi (Chemonics)*** was fielded in December to assist WRS with the implementation of the reuse of treated wastewater in Drarga.

4. Meetings Attended

Table 1 below summarizes the key meetings and workshops organized or attended by WRS staff in 2000.

Table 1

Key Meeting Attended in 2000

Meeting Description	Participants	Date
Filming of the television program "Dounya" in Fes	WRS, RADEEF, Tannery Saiss	January 16
Workshop on "clean tanning" in Fes	WRS, MOE, RADEEF, AFD, Tanners	January 18
Visit of Dokkarat plant construction	WRS, USAID, Chemonics, MOE, RADEEF	January 19
Visit of the Nakhla watershed	WRS, Chemonics	January 20
Presentation of WRS activities to USAID's water team in Washington	WRS, USAID	February 3
Meeting with Peace Corps on Nakhla	WRS, Peace Corps	February 8
Meeting with the local steering committee in Fes	WRS, RADEEF, Wilaya, MOE, El Mokha	February 16
Meeting with USAID	WRS, USAID	February 17
Meeting on Nakhla contrat-programme	WRS, DPA	February 23
Meeting of norms and standards committee	WRS, MOE	February 24
Meeting of Fes steering committee	WRS, RADEEF, Wilaya, MOE, El Mokha	March 6
USAID Forward project debriefing	WRS, USAID, Forward Team	March 10
Meeting of Agadir steering committee	WRS, Commune, Al Amal Association, MOE, Majestic	March 16
DCM's visit to the Nakhla watershed	WRS, USAID, U.S. Embassy	March 28, 29
Workshop for journalists of Fes and Meknes on environmental issues	WRS, MOE, journalists	March 30

Table 1

Key Meeting Attended in 2000

Meeting Description	Participants	Date
Meeting on progress of the Drarga wasetwater treatment plant	WRS, Commune of Drarga, Contractors, MOE	April 13
DCM visit to the Dokkarat chromium recovery plant	US. Embassy, USAID, WRS	April 20
USAID contractors conference	USAID, contractors	April 21
Integrated Water Management conference in Agadir	USAID, WRS, SIWM, MOE, DRH, Agriculture	April 26 - 27
Meeting on progress of the construction of the Dokkarat chromium recovery plant	WRS, MOE, RADEEF, Wilaya, contractors	May 4
Visit of the Nakhla soil erosion control site	WRS, DPA	May 5
USAID debrief of Marie Aziz mission	WRS, USAID	May 10
Meeting with Agence du Nord on Nakhla	WRS, Agence du Nord	May 11
Workplan review by MOE	WRS, MOE	May 16
Meeting with SIWM Team	WRS, SIWM	May 17
Conference on soil science	WRS, ENA Meknes, IAV, MOE	May 18 - 19
Peace Corps Environmental Education Conference	WRS, Peace Corps, Teachers	May 26
Inauguration of Dokkarat chromium recovery plant	US. Embassy, MOE, USAID, Wilaya of Fes, WRS, RADEEF	June 5
Meeting on cost recovery by the Commune of Drarga	WRS, Commune of Drarga	June 8 - 9
Meeting to verify construction of the Fes facility	WRS, Wilaya, MOE, RADEEF	June 23
USAID contractors meeting	USAID, Contractors	June 27
International Water Association Conference - Paris	IWA, WRS	July 3 - 7
Meeting on SO6	WRS, USAID, SIWM	July 10
	WRS, Wilaya,	

Table 1

Key Meeting Attended in 2000

Meeting Description	Participants	Date
Meeting of regional committee - Fes	RADEEF, MOE	July 11
Conseil National de l'Environnement	MOE, WRS	July 28
WRS dissemination strategy meeting	USAID, WRS	July 31
Meeting of regional committee, Agadir	WRS, Commune of Drarga, ERAC, Majestic	August 23
Meeting on SIWM indicators - Agadir	WRS, USAID, SIWM	August 24
Debrief on SIWM indicators	USAID, WRS, SIWM	September 11
Presentation of SIWM workplan - Agadir	USAID, SIWM, WRS, Equipment, Agriculture, ONEP, RAMSA, Wilaya of Agadir, MOE	September 14
Site visit of Drarga	WRS, USAID	September 21
Workshop on private participation in water services - Sharm el Sheikh, Egypt	USAID, WRS	September 26 - 29
USAID Debriefing by John Woods on the WRS Communication Strategy	USAID, WRS	October 6
Meeting of the Nakhla regional committee	WRS, MOE, DPA of Tetouan, Agence du Nord, Wilaya of Tetouan, Ministry of Agriculture	October 12
Inauguration of the Drarga wastewater treatment plant	Minister Yazghi, U.S. Ambassador Gabriel, Wali of Agadir Rarhabbi, USAID Director Bednar, WRS partners	October 31
Workshop on the lessons-learned from the Drarga project	MOE, Wilaya of Agadir, Commune of Drarga, DRH, ORMVA, RAMSA, ONEP, Health Delegation, WRS	November 1
Symposium on environmental catalytic processes	MOE, WRS	November 13 - 14

Table 1

Key Meeting Attended in 2000

Meeting Description	Participants	Date
Workshop on the lessons-learned from the Nakhla project	MOE, DPAof Tetouan, Ministry of Agriculture, Eaux et Forets, Agence du Nord, USAID, WRS	November 15 - 16
Training on operation of Drarga plant	WRS, MOE, Commune of Drarga, ONEP, RAMSA, Wilay of Agadir	November 17
Site visit of Nakhla farmers to Meknes	Nakhla farmers, DPA of Tetouan, WRS	November 20 -21
Meeting of the Fes oversight committee	WRS, MOE, RADEEF, Wilaya of Fes	November 23
Meeting on regional tourism development in Agadir	WRS, SIWM, Agadir instutitions concerned with tourism	November 23
USAID debrief by David Mulla	WRS, USAID	November 24
Meeting of the Fes oversight committee	WRS, MOE, RADEEF, Wilaya of Fes, CID	December 5

5. Deliverables

Table 2 summarizes the deliverables submitted in 2000.

Table 2

Deliverables Submitted in 2000

Deliverable Title	**Date**
Annual Work Plan 2000	January 2000
Elaboration de valeurs limites pour les rejets liquides des tanneries au Maroc" **Avijit Dasgupta & Paul Larochelle**	February 2000
Annual Report January 1st - December 31, 1999	February 2000
First Quarter 2000 Progress Report	April 2000
Annual Work Plan 2000 - Last Version	June 2000
Rapport de l'atelier sur la gestion des ressources en eau dans le Souss-Massa	April 2000
Calendrier des travaux apicoles à suivre pour le rucher de Oued Nakhla **Mohamed Sarehane**	June 2000
Entretien du rucher collectif d'Azerka à Oued Nakhla **Mohamed Sarehane**	June 2000
Formation des apiculteurs sur les techniques apicoles durant la période du printemps du rucher d'Azerka **Mohamed Sarehane**	June 2000
Second Quarter 2000 Progress Report	July 2000
Manuel de fonctionnement et de maintenance pour la station de Dokkarat - French Draft Version	August 2000
Manuel de fonctionnement et de maintenance pour la station de Drarga - French Draft Version	September 2000
Evaluation à mi-parcours du projet pilote de Nakhla **Mohamed Mahdi**	September 2000
Elaboration de valeurs limites pour la réutilisation des eaux usées en irrigation - Draft Version **Dimitri Xanthoulis**	September 2000
Third Quarter 2000 Progress Report	November 2000
Annual review pilot project for control of soil erosion in the Oued Nakhla Watershed	November 2000

Table 2 **Deliverables Submitted in 2000**	
Deliverable Title	**Date**
David Mulla	